

Sustecture Lessons from Underground Spaces in Traditional Architecture of Developing Countries

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Abstract

The use of the land as a location of the architecture project is an issue that originates from the beliefs and history of world architecture. Human, since the beginning of creation, has used utilization of underground levels as one of the best places to live. *Rapaport's* studies (1969), emphasized the importance of the use of the underground levels in the primitive's houses. This issue has a long record in the traditional architecture of the East, especially Iran's traditional architecture; so that many brilliant and valuable architectural projects somehow have used the underground levels. The techniques that have been used in those buildings, in addition to saving the energy, have significant aesthetic aspects. Many of these techniques can be used in architectural design in the contemporary era. Hence, the main questions of this study are: 1-what are the most important lessons of traditional Iranian architecture about the use of sustainable technologies? 2-How can be applied the lessons from traditional architecture in contemporary architecture as well? To answer the research questions, logical reasoning analysis methods is used, with descriptive - Analytic techniques. As a sample, the *Aqa Bozorg School* and mosque in *Kashan*, an innovative example of traditional Iranian architecture, has been selected for analysis. For this purpose, primarily based on objective observation and the existing documents, design criteria of this magnificent monument that leads to beauty, durability and sustainability this building, has been extracted. The strategies using and applying these criteria to the guidelines and policies on the use of sustecture in contemporary architecture have been investigated. Results of the study indicate that traditional Iranian architecture is full of significant innovative lessons, which can be used in the field of contemporary architecture also.

Keywords

Traditional Architecture; Sustecture; Underground Spaces; Aqa Bozorg School of Kashan

Introduction

Sustecture is a word which is derived from three determining words i. e. sustainable, high-tech and

architecture. Sustecture considered as utopia in contemporary architecture of developing countries such as Iran; therefore it worth concentrating especially through traditional architecture point of view. This paper is to derive sustecture lessons from underground spaces in traditional architecture of developing countries, which concentrated on Aqa Bozorg School in Kashan.

State of Issue

There is no debate each building must be located in relation to the natural environment. The challenge is what kind and how this relationship is best. Nowadays, the idea of sustainable architecture has been proposed to address these questions, in order to create a stable environment for human life. The concept of Sustainable Development essentially means keeping current development within sustainable levels, thus protecting the needs and resources of both the environment and human population, in the longer term. This term, the principles of Sustainable Development, originally came from the *Bruntland Report* in 1987, written up in the book "Our Common Future". (Mahdavinejad et al., 2013: 802-811) In its guiding statement, the authors stated that: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable Development is ultimately intended to curb the excesses of human exploitation of the earth's natural resources, by imposing limits to our growth, expansion, and development. Progress on developing the concepts of sustainable development has been fast since the term was first coined. In 1992 leaders at the Earth Summit in Rio de Janeiro developed these concepts further and created agreements on such key areas such as deforestation, desertification, and the hot topic of today, climate change. Young Ken believed that sustainable ecological design can be considered as

a kind of design throughout their life cycles that are complete harmony with the Earth's ecological systems. Another definition of sustainable design in Richard Rodgers called a design that aims to answer today's needs without damaging resources for future generations. Key points in a design are the consumption energy in low level, the high flexibility and efficiency in resource utilization.

Sustainable architecture discussion with an emphasis on sustainable technology refers to Sustecture that is issue that follows environmental and reduce energy waste. In this architecture, the building tries to adapt to climatic conditions of the region and interact with it. As Richard Rogers said that the buildings are like birds in winter dressed their feathers to adapt it to regulation based on metabolic adaptation. Today, the term sustainability is used for a wide range of sensitive approaches to environment, from traditional architecture known as a kind of ecological sustainability and social architecture to others which have endeavored with reconciliation and the interaction between technology and ecology to operate both useful features.

Sustainability, with specific principles generally three steps are: Conservation of resources; Designed to return life cycle; and design for humans, each have their own specific strategies. Identification and study of these measures will help architecture to know and evaluate the environment need to treat on base of sustainability in design. Sustainability goals include: Accenting to human life and preserved for present and future; the materials used are homogene with the environment and sustainable during the production, use and destruction; The minimum use of fuel energy and maximum utilization of natural energy; The least damage to the environment; Improve the physical and mental lives of all creature; and harmony with the natural environment. Based on the principles that should be applied in this architecture, these include: Perceived sense of place and do not interruption; The use of natural energy such as solar, wind, etc; Use of natural and local materials can be recycled and durable; Collect rain water and efficient use of flow water; Heat insulation, sound and isolated fixture; Natural ventilation and roof support capabilities; Accurate designed light style and windows. (Gorji mahlabani, 2011) The need to use Sustainable technologies is so important in this paper to survey the objective buildings which have applied them to became stable and durable throughout the years as continue to operate and maintain its performance and

responds to the needs of users so here briefly mentioned the sustainable architecture and technologies in Iran.

Sustainability in Traditional Architecture

Aqa Bozorg mosque and school is one of the most beautiful and noble traditional mosque-school in Iran that is belong to *Ghajar* era. This building is located in *Kashan*. It is a valuable complex of architectural and embellishment elements that have got appropriate combination of masses and organs. The main masses of this building are included of entrance hall, two courtyards in two-story, *Gonbad Khane*, *Shabestan*, *Bad-Gir* and so on.

The entrance hall include two floors, locataed the front of building. In the first floor, after door, there is a Vestibule with two corridors on two sides and there is a porch in front of it that have access from that corridors. In fact this is the roof of main hall in underground floor that has been design in porch shape. Those corridors connect the entrance to both above-courtyard and underground spaces. One minor and small courtyard is located along them that supply access to porch. Our papers demonstrate these courts in addition to provide access, Figure 1 result in the appropriate and desirable corridor because of providing connection with open spaces.

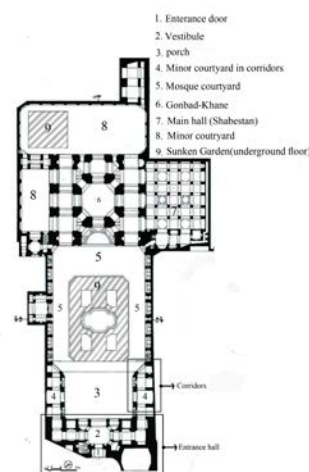


FIG. 1 FIRST FLOOR PLAN, GANJNAME (2001).

After corridors there is mosque's courtyard that has been designed like a semi-open space. This courtyard in above-floor is the roof of school space. It's a perfect design in architecture that be able to provide additional courtyard in underground spaces. In the other hand some part of the underground floor has been design like a semi-open space. It is the most wonderful part of this building that has caused a lot of advantages for whole building (Figure 2, 3). Some are

as below:

- To open parts of the roof of underground spaces and to provide open space for them;
- To make modify climate situation in building in natural way because designing in proportion to region climate;
- To create spatial and visual variety;
- Optimum use of land for providing maximum needed spaces;
- To provide natural light for underground spaces;
- To decrease unpleasant feeling of being in underground and closed spaces;
- To combine open, closed and semi open spaces with each other.



FIG. 2 GENERAL VIEW OF COURTYARD, FACING SOUTH



FIG. 3 GENERAL VIEW OF COURTYARD, FACING NORTH

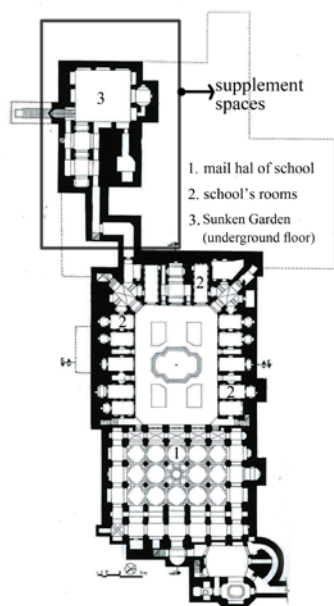


FIG. 4 BASEMENT AND SUNKEN GARDEN GANJNAME (2001)

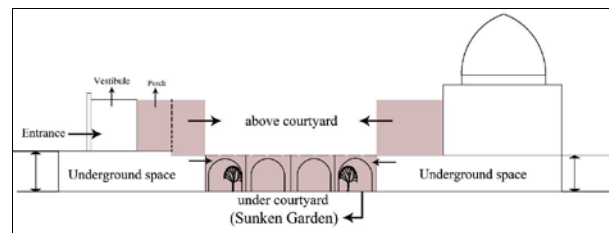


FIG. 5 CONCEPT OF SUNKEN GARDEN IN DESIGN OF UNDERGROUND SPACES AS AN ECO-FRIENDLY BUILDING.

The under courtyard -school's courtyard- has access way with stair from four sides that is linked with corridors. The rooms and halls are located around the under courtyard, eastern and western rooms get access from long corridor in back. Some supplement spaces have been located In the end of underground floor, designed modulation of open and closed spaces.

In follow, on the basis of cognition of building design, the architectural techniques that make this building one of the novel cases in sustainable technology, are analysed according to sustecture factors. This analysis indicate how the thoughtful and artistic using of underground spaces can make a positive effects and finally create unique sense of place and sustainability.

Natural Ventilation

The use of open spaces for each floor in buildings with *Godal Baghche* method have supplied all inner spaces with having natural weather and make better psychological feeling and modify microclimate.



FIG. 6 GENERAL VIEW OF THE COURTYARD FACING NORTH

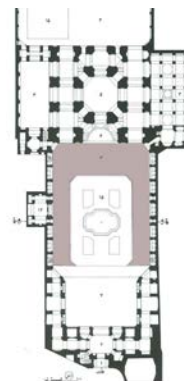


FIG. 7 MOSQUE'S COURTYARD AS A SEMI-OPEN SPACE

Courtyard is one of the most impqrtant structural element of mosque. The semi-courtyard shape create

another open space for underground spaces. This way is the optimum use of space for two different functions in spite of shortage land, provides so natural light, visual variety, wonderful view and perfect sights,

Create wind catchers as air vents with other architectural elements like as *Godal Baghche*, basement, minor corridors and semi-open spaces as a unique system that rule as a natural ventilator

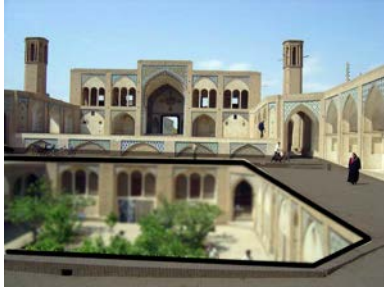


FIG. 8 MOSQUE'S COURTYARD AS A SEMI-OPEN SPACE

Create minor open spaces among whole masses has promote access of inner spaces to the sky and natural weather.

Natural Cooling and Heating

Bad-Gir (ventilator) is creative natural technology in hot climate of desert leads wind inside underground spaces especially main hall of school (Shabestan) to cool and fresh air with help of its basement and ghanat.

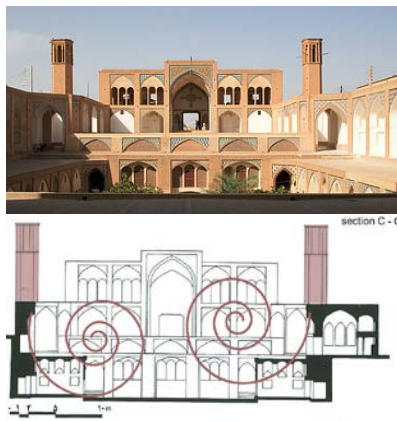


FIG. 9-10 BADGIRS AND NATURAL VENTILATION

- The use of pool and trees in *Godal Baghche* cools and leads wind to other spaces;
- Open space in four sides leading to have more cool space in summers ;
- Use double wall preserves the heat in the building like as dome;
- Create both summer and winter part in building with *Godal Baghche* and central courtyard that could be used in proportion to warm and cold season;

- Benefit from the Natural light;
- Create a small and minor courtyard in narrow corridors as an open space to connect closed space to open space

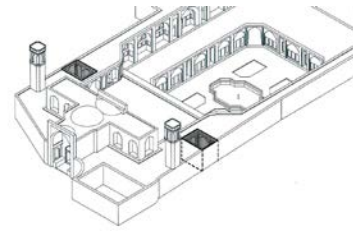


FIG. 11 MINOR COURTYARDS IN NARROW SPACES

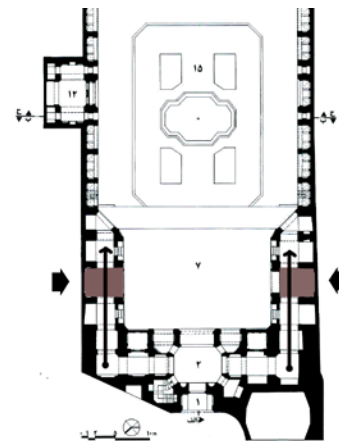


FIG. 12 LOCATION OF MINOR COURTYARDS IN NARROW SPACES

Create some minor courtyard in underground and aboveground floors as an access ways to minor room and welfare facilities, to reduce mass of building and to give more attraction to minor underground space

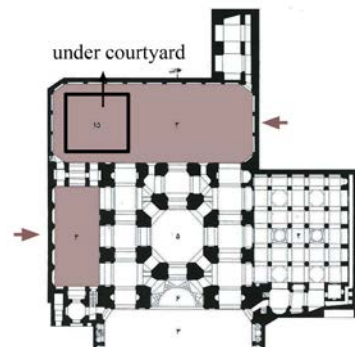


FIG. 13 LOCATION OF MINOR COURTYARDS FOR DECREASE MASSES

Create a foyer as an entrance for corridors has helped to multiuse of spaces , act functional and formal efficiently, make wonderful view and connect between outside and inside of building.

Porch in entrance hall as a part of entrance is the roof of other part of underground building , gives views from the site and open spaces also connects outside and inside .

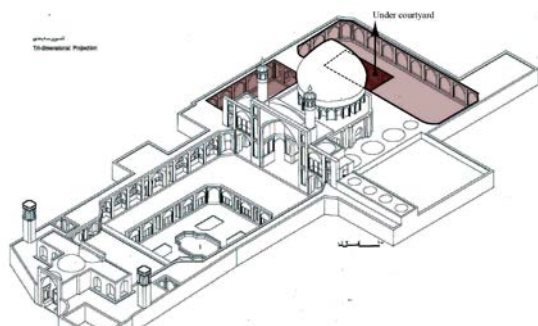


FIG. 14 MINOR COURTYARDS FOR DECREASE MASSES AND - CONNECT OTHER SPACES TO SKY

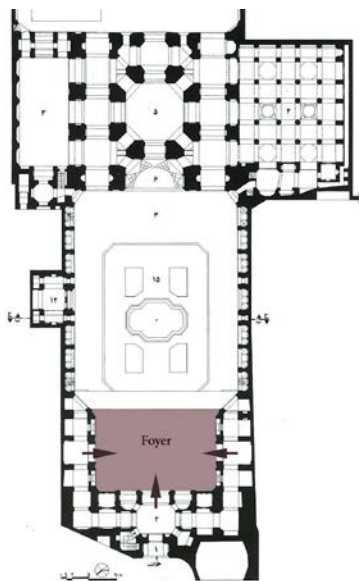


FIG. 15 LOCATION OF FOYER



FIG. 16 FOYER

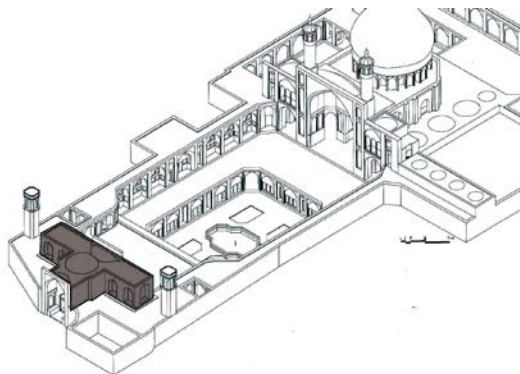


FIG. 17 LOCATION OF PORCH

Adapt to Site and Context

- Use central courtyard that is adapted to local

climate;

- Integrate two different functions in limited land that each with enough space can rules independently .

Efficiency Use of Materials

- Use local texture mostly brick.
- Optimum use of amount materials with use of Golad Baghche method and supply some part of needed materials from waste of it and access to Qanat waters sources.

Conclusion

The most important feature of this building is to combine two different functions in a small and limited land so each can act as a self-sufficient building and provides all its needed spaces without any disturbance in functions. Achieving the aim, the architect has used the underground spaces concept especially *Sunken-Garden* or *Godal-Baghche*, the combination of open and closed spaces that lead to some semi-open spaces. This idea has caused a lot of variety in mass and visual condition. Also the concept of underground space with *Sunken-Garden* method is very suitable for the climate helps to modification air condition in building. *Sunken-garden* and *Bad-Gir* are salient examples as natural ventilators in building. The most important feature of the traditional building are:

- Functional efficiency ;
- Spatial and visual variety ;
- respect to sustainability criteria;
- economize using land and promote the optimum use of space;
- use natural condition for underground spaces;
- create an attraction for underground spaces and make desirable them with connection to open spaces;
- shift the underground and corridors from narrow and unpleasant routes to attractive and functional locations;
- Adapt building in climate with whole factors;
- Use natural resources for ventilating building through creative architectural elements;
- Use a little energy as possible by thoughtful design;

All the above mentioned notes show that in design of underground spaces in this traditional building, just the functional aspects has not been under

consideration, also other aspects like as aesthetic and psychological ones in a same important has been noticed. Finally all this items has caused this building act as a sustainable system can be used as a template

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